HEAT RADIATION OF THE STARS.

As every one knows, meteorology deals only with the heat received from the sun and its action on the earth and atmosphere. Those who believe in the influence of the moon and stars have never been able to show that these exert any appreciable influence on meteorological phenomena. The refinement to which scientific measurements have been pushed, and the exceeding minuteness of the heat effects, if any, are well shown in the following article by Prof. George E. Hale, quoted from Popular Astronomy.

In an important paper published in 1890,[1] Prof. C. V. Boys describes his unsuccessful attempts to detect heat radiations from the stars by means of an exceedingly delicate radiometer used in conjunction with a 16-inch reflecting telescope. In spite of the fact that his apparatus was sensitive enough to show the heat equivalent to that of a candle 1.71 miles away, no effect whatever could be obtained from Venus, Jupiter, Saturn, Mars, Arcturus, Capella, Vega, or any of the numerous bright stars observed. After discussing the earlier papers of Huggins[2] and Stone,[3] Professor Boys concludes that the heating effects of stars, obtained many years ago by these observers with comparatively insensitive apparatus, were spurious.

The work of Dr. E. F. Nichols, Professor of Physics in Dartmouth College, in perfecting the radiometer, and adapting it for the measurement of heat radiations, has placed astrophysicists in possession of an instrument which for certain purposes is superior to the radiomicrometer, bolometer, or most improved form of thermopile. In view of the remarkable sensitiveness of the radiometer and its suitability for stellar work, Professor Nichols was invited to make an attempt to detect stellar heat radiations with its aid at the Yerkes Observatory, Williams Bay, Wisconsin. The investigation was accordingly undertaken in July, 1898.

The experiments were made in the heliostat room of the Yerkes Observatory, where the radiometer, stably mounted upon a heavy pier, could be shielded from air currents and other sources of disturbance. The great steadiness of the reflected image of the scale, making it possible to record deflections to tenths of a millimeter, was doubtless due to this arrangement.

The radiometer, constructed by Professor Nichols especially for these experiments, essentially consists of a suspension system formed of two mica discs, each 2mm. in diameter, blackened on one face, and supported by a light cross-arm on either side of a thin glass staff, hung by an exceedingly fine quartz fibre in a partial vacuum. Both vanes were exposed to the radiation of the sky, at the focus of a silvered glass mirror of 24 inches aperture and 8 feet focus, made by Mr. G. W. Ritchie, optician of the Yerkes Observatory. Rays from the star were reflected into the concave mirror by means of a siderostat[4] having a large plane mirror of silvered glass. After reflection at the concave mirror and also at the surface of a small flat one fixed at an angle of 45° with the optical axis, the rays entered the radiometer through a fluorite window.

With this apparatus a deflection of 0.1 mm. would be given by a candle 15 miles away, assuming total reflection at the silvered surfaces and neglecting atmospheric absorption. When the moon's image is made to fall on one of the vanes, the scale is instantly thrown out of the field of view. Prosessor Nichols' radiometer is about five times as sensitive as Boys' radiometer, and the area of his telescope mirror is 2.4 times that of the mirror used by Boys. In Professor Nichols' apparatus there is, however, one additional reflection.

Seven determinations of the heat radiation of Arcturus, made on August 4, 5, 7, 8, 9, 11, and 13, gave a mean deflection of 0.60 mm. Each evening's determination is the result of from 21 to 47 deflections, and the probable error of the corresponding means ranges from 0.08 mm. to 0.17 mm. Vega was also observed on seven nights, and gave a mean deflection of 0.27 mm. The ratio of the heat radiation of Arcturus to that of Vega, determined on five nights, is 2.1, 2.0, 3.0, 2.3, 1.0;[5] mean, 2.1. These results are not corrected for atmospheric absorption.

In all cases the observer was ignorant of the probable direction of the deflection, and other precautions were taken to avoid bias. The results appear to be trustworthy, and the probable errors are not greater than might be expected in such observations. In view of the smallness of the deflections and the uncertainty which arises from the rapid fluctuations in the atmosphere, Professor Nichols does not greatly rely upon the quantitative value of the results. They may fairly be considered to show, however, that we do not receive from Arcturus more heat than would reach us from a candle at a distance of five or six miles, no account being taken in the latter case of atmospheric absorption.

[1] Proceedings of the Royal Society, vol. 47, p. 480, 1890.
[2] Ibid., vol. 17, p. 309, 1869.
[3] Ibid., vol. 18, p. 159, 1870.
[4] Kindly loaned by the Allegheny Observatory.
[5] Sky very hazy.

THE FIRST VOLUME OF THE MARYLAND WEATHER SERVICE.

The publication of the first volume of the Maryland Weather Service marks quite an interesting epoch in the history of the development of the State weather services of this country. In so far as independent State services are maintained, their directors must necessarily develop and apply their energies in those directions that will best tell for the interests of the States. In this respect, Maryland has been highly favored. Prof. Dr. Wm. B. Clark, who founded the State weather service, and secures its annual appropriations from the State Legislature, has also received such hearty cooperation from the Chief of the United States Weather Bureau that we have here practically two institutions working side by side in complete harmony, viz, the Maryland Section of the Climate and Crop Service of the United States Weather Bureau, of which Mr. F. J. Walz is Section Director, and on the other hand, the Maryland Weather Service of which Professor Clark is director.

The Maryland Section is maintained entirely by the United States Weather Bureau, and does all the expensive routine work that is performed by similar sections throughout the country. The Maryland Weather Service expends its energies in developing a greater interest in meteorology, lecturing and teaching and stimulating the production of special memoirs, which it proposes to publish in the magnificent style of which the present first volume is an illustration. Nothing like this, in the way of paper, presswork, illustrations, and typography, so far as we know, has ever before been published anywhere in the world in the interests of meteorology. Such a magnificent volume commands admiration from all who have any bibliographic taste, as well as from those who are interested in the scientific subject-matter.

The idea of devoting the energies of the local State service to memoirs rather than to daily, weekly, monthly, and annual bulletins and reports is a highly important step in the development of our science. For a century past, well established astronomical observatories had been famous for publishing great volumes of figures, showing the results of actual observations and stars, when, about 1840, Struve announced that the new observatory at Poulkova would publish memoirs as fast as they could be properly prepared, but would not, for the present, publish annual volumes of observations. In meteorology, as in astronomy, all important progress must be embodied in the memoirs that contain the results of the investigations of able physicists. As preliminary to these, observations and minor studies must be made and published. Every brilliant memoir that marks the upward pathway of science has been preceded by years of less brilliant work—the so-called "grind" of daily routine. After clearing away the errors of the past, it becomes possible to obtain new and more correct views, just as one cuts down the forest in order to let the sunshine in. We understand that the succeeding volumes of the series that Professor Clark has thus happily begun, will be devoted to monographs on meteorological and climatological matters intimately connected with the commercial, financial, and agricultural welfare of Maryland. This implies that he will secure a high grade of employees as investigators and statisticians, in order that the subject-matter may command as high a degree of admiration as does the typographical aspect of the volume. It is evident, therefore, that in future we must look to Maryland and its weather service as one of the most successful patrons of high class work in meteorology.

Among the many words of praise for this first volume we quote the following:

J. R. Sage, in the Monthly Review of the Iowa Weather and Crop Service for October, says:

The board of control is composed of William Bullock Clark, director, representing the Johns Hopkins University; Milton Whitney, secretary and treasurer, representing the State Agricultural College, and Ferdinand J. Walz, meteorologist, representing the United States Weather Bureau. By means of a liberal State appropriation to cover necessary expenses, and a wisely devised system of cooperation, these three great scientific and educational forces are doing a great work for the people of that commonwealth. * * * * * *

In the production of this great work the Maryland Weather Service has taken the lead of all similar auxiliary services in the Union, demonstrating the value of cooperation of the State with the National Bureau in the dissemination of scientific and practical knowledge among the people. Every State in the Union may wisely follow that lead by establishing some system of cooperation whereby every section may enjoy the full measure of benefits to be derived from the generous helpfulness of the Government.

Mr. Alexander McAdie, in the October report of the California section, says:

Maryland now enjoys the result of a well-considered plan, worked out with care by competent laborers. * * * * *

It is clearly shown in a volume of this character that a knowledge of the climatology of a country is of great practical value to the merchant, engineer, the doctor, and, above all, the farmer. What such information is worth on the Pacific coast let agriculturist, miner, stockman, and engineer tell. Particularly at this time, when the Pacific seems destined to become the great connecting link between the civilizations of the new and old worlds, is it important that we should have climatic information complete as knowledge, skill, and means can afford. Meteorology may be, as sometimes stated, "the border land where physics, chemistry, and geology meet;" but climatology in the broadest sense embraces all the applied sciences. It weaves together many separate strands into a knowledge of the controlling factors of life; not only the life of an individual, a community, or a nation, but even of continents and worlds. A study of the climatic data of the Pacific coast as comprehensive as this work which issues from Maryland would be the starting point in the solution of the problems of climatic evolution which are discernible on the Pacific coast perhaps in a more marked degree than elsewhere.

Mr. R. DeC. Ward, in Science for December 1, says:

A new era has opened for climatology in this country. * * * The present volume is decidedly "*bahn-brechend.*"

THE DIRECTOR OF THE IOWA WEATHER AND CROP SERVICE.

We quote the following from the October report of the Iowa Weather and Crop Service. As is well known this service, like that of Maryland and some other States, has an independent appropriation of its own, and its monthly review has been a most valuable contribution not only to scientific literature, but especially to the popular literature of this subject. Its trenchant attacks on errors and instructive articles and practical suggestions on matters of daily importance have made the journal and its editor well known throughout the country. We welcome him as a valuable addition to the corps of the Weather Bureau, with which he has so long been in hearty cooperation.

By a special order of the President the director of the Iowa Weather and Crop Service was recently brought into the classified service, and was appointed by Secretary Wilson a section director of the Climate and Crop Service of the United States Weather Bureau, said appointment taking effect October 1, 1899. This honor is most highly appreciated because of the fact that it came without personal solicitation or political influence, accompanied by very pleasant messages from the Secretary of Agriculture and the Chief of the Weather Bureau, commendatory of the work that has been done in Iowa during the past ten years. This appointment does not imply any change in the existing system of cooperation of the United States Weather Bureau and the Iowa Weather and Crop Service, except that it may enlarge its scope and make the bond of union closer and more effective for good results. It is certain that the results achieved during the past decade have been more valuable than could have been secured without such cooperation, though justice requires the statement that the National Weather Bureau has been the major factor in this joint enterprise. The State, through its moderate appropriation, has undertaken to supplement the Government along practical lines, thereby securing a larger measure of the benefits of scientific investigation, and promoting a general knowledge of the climatology of this great agricultural section. How well this beneficent end has been attained the people of Iowa may be allowed to judge.

RAINFALL AND RIVERS IN IDAHO.

In his October report of the Idaho Section, Mr. S. M. Blandford, Section Director, gives some account of the discharges of the rivers during 1898. He says:

All of the rivers of Idaho that have received the attention of the Division of Hydrography have their source in the mountains of Idaho, except the Snake River. The drainage area of the Malade, Little Wood, Boise, and Weiser rivers is 7,580 miles, and with the exception of the Payette, embraces all of the important rivers that flow into the Snake from the north. * * * * * *

The normal precipitation in Idaho ranges from 40.30 to 8.41 inches. In Shoshone County the annual precipitation, 40.30 inches, is equivalent to that of southern Maryland, and the precipitation of Kootenal and Latah counties, which ranges from 22 to 25 inches, is sufficient for the needs of vegetation. In Fremont and Bear Lake counties, and the eastern sections of each of the southeastern counties, grains and grasses mature on unirrigated lands during years of normal precipitation with an equitable distribution of rainfall during the crop growing season. However, more than seven-tenths of the area of Idaho is semiarid. It is in the semiarid sections where the annual precipitation ranges from 9 to 15 inches over the valleys and plains, to 20 and 27 inches near the summit of the mountains, that the Division of Hydrography has made river discharge measurements. During 1898 the annual precipitation over the drainage area of the rivers in the above table [omitted] was considerably less than the normal, the deficiency ranging from 1 to 5 inches.

THE CENTRAL OFFICE OF THE ILLINOIS SECTION.

It is announced that the central office of the Illinois Section of the Climate and Crop Service was removed on November 25 from Chicago to the office of the United States Weather Bureau at Springfield, Ill. The Section still continues in charge of Mr. Charles E. Linney, Section Director. In general, it is found best that section centers should be at the capitals of the respective States, and we doubt not that in his new location, which well represents the climate and the agricultural interests of Illinois, Mr. Linney will come into those intimate relations with the farmers and the legislators that were not easily attained when he was located within the influence of the rush of commercial business in Chicago. By thus establishing two meteorological centers within the State, the light of knowledge will, doubtless, be more uniformly diffused.

IRRIGATION BY WIRE.

In the continuation of the correspondence published on page 301 of the MONTHLY WEATHER REVIEW for July, Mr. Arthur Betts writes, under date of October 17, as follows:

In reference to the statement that "the 0.13 inch of dewfall was more than twelve times that amount by wire (1.58 inch)" bear in mind that I did not catch the one forty-ninth part of the drip from the wire. The largest part of the drip was wasted on the ground beneath. To have caught it all would have required a basin 7 feet square and 1.58 inch deep. A closer network of wire would have increased the amount of drip. Perpendicular wire would not answer. A horizontal wire 1 rod long would irrigate every inch of the rod, but when hanging vertically, only a little spot.

The following extracts are taken from a letter addressed to Mr. Arthur Betts by Mr. A. D. Elmer of Northfield, Mass., and communicated by the former to the Editor for publication in the MONTHLY WEATHER REVIEW: